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THE EXPLORATION
OF THE
POTTER CREEK CAVE

BY

WILLIAM J. SINCLAIR

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Interior of the main chamber of Potter Creek Cave. Looking toward the southeast from the top of the earth slope in the northwest end. Drawn from photograhs.

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CONTENTS.

INTRODUCTION.

The limestone caves of California have only recently received the attention due them as localities which have afforded exceedingly favorable opportunities for the entombment and preservation of the remains of man and of the Quaternary fauna of this coast. Some of the most reliable evidence regarding the existence of man during the Quaternary has been derived from the caves of Europe. North American caves have been largely overlooked,

and it is only rarely that they have been made the subject of special or extended investigation by the anthropologist and the palaeontologist.

The work of cave exploration has been undertaken by the Department of Anthropology of the University of California, as a part of the investigation being carried on with a view to determining the antiquity of man on this coast. It has received the generous support of Mrs. Phoebe A. Hearst and has been conducted under the immediate direction of Professor J. C. Merriam.

The existence of bones in the Potter Creek cave was first discovered in 1878, by Mr. J. A. Richardson, who found there the skull of a large extinct bear afterwards described by Professor Cope as the type of a new species.* Later, Professor Cope in company with Mr. Richardson visited the cave, but Cope did not descend into the chamber where Richardson's discoveries were made, assuming that there was nothing of value remaining.

The cave was rediscovered by Mr. E. L. Furlong of the University of California in July, 1902. Mr. Furlong excavated a part of the deposit on the floor of the main chamber, finding a large number of bones pertaining to extinct species. On Mr. Furlong's return to Berkeley, the exploration was continued by the writer and was completed in the summer of 1903.

The present paper is a report on the exploration of the first of the Californian caves in which excavation has been systematically conducted. It has been thought best to reserve for separate publication the descriptions of new species discovered, and to present here the results of more general interest.

The writer desires to express his obligation to Professor F. W. Putnam, the head of the department, for the privilege of conducting this investigation and to Professor J. C. Merriam who has planned and supervised the work and has furnished the list of cave carnivora. Dr. C. Hart Merriam has generously given of his time in the determination of many of the mammals. The fish remains have been studied by President David Starr Jordan. Professor C. A. Kofoid has undertaken the study of the blind spiders collected in the cave. Mr. E. L. Furlong has furnished valuable information regarding

* *Arctotherium simum*, Am. Nat. XIII., p. 791; XXV., pp. 997–999, Pl. XXI.

Looking east across the McCloud River from Baird. The 240-foot terrace is shown above the river on the right, the 90-foot terrace above the buildings on the left. The pointer indicates the ridge in which the cave lies.

the stratigraphy of that portion of the bone-bearing deposit which he excavated. To Mr. J. S. Diller the writer is indebted for information which has been of great value in studying the topographic development of the region in its relation to the cave.

The results of the exploration were secured by leases kindly given to the University by the controllers of the property, Dr. W. C. Bruson and Mr. D. P. Doak.

DESCRIPTION OF THE CAVE.

The Potter Creek cave is situated in Section 23, Township 34 North, Range 4 West, Mount Diablo Meridian. It derives its name from its location in the high bluff on the north side of Potter Creek. The cave is about one mile southeast of the United States fishery station at Baird, on the McCloud River (Pl. 2). It lies in a belt of Carboniferous limestone (McCloud limestone) at an elevation of 1500 feet above sea level, and about 800 feet above the level of the McCloud, at the mouth of Potter Creek (Pls. 8 and 9).

The system of galleries forming the cave trends in a northwest-southeast direction approximately parallel with the strike of the McCloud limestone. The arched entrance (Pl. 3) communicates with a smaller chamber through which admittance is gained to a narrow passageway. Beyond this point the explorer must depend for light on lamp or candle. Following this passage to the left, it is found to terminate abruptly on the margin of a great pit. Here a convenient stalagmite pillar offers a secure point of attachment for a rope ladder. A vertical descent of forty-two feet affords entrance to a room one hundred and seven feet long, about thirty feet wide at its widest part, with the roof rising about seventy-five feet above the lowest point of the floor (Pl. 1). Both walls of the chamber slope toward the west. The west wall overhangs, and is fringed with numerous massive pendants, some of which are shown in Plate 4.

Forming the floor of this great room were two fan-like deposits of earth and stalagmite-cemented breccia, sloping from opposite ends of the chamber and coalescing at their borders. (Pls. 1, 5, 6, 12, 14). Above the apices of the fans rose almost vertical chimney-like openings.

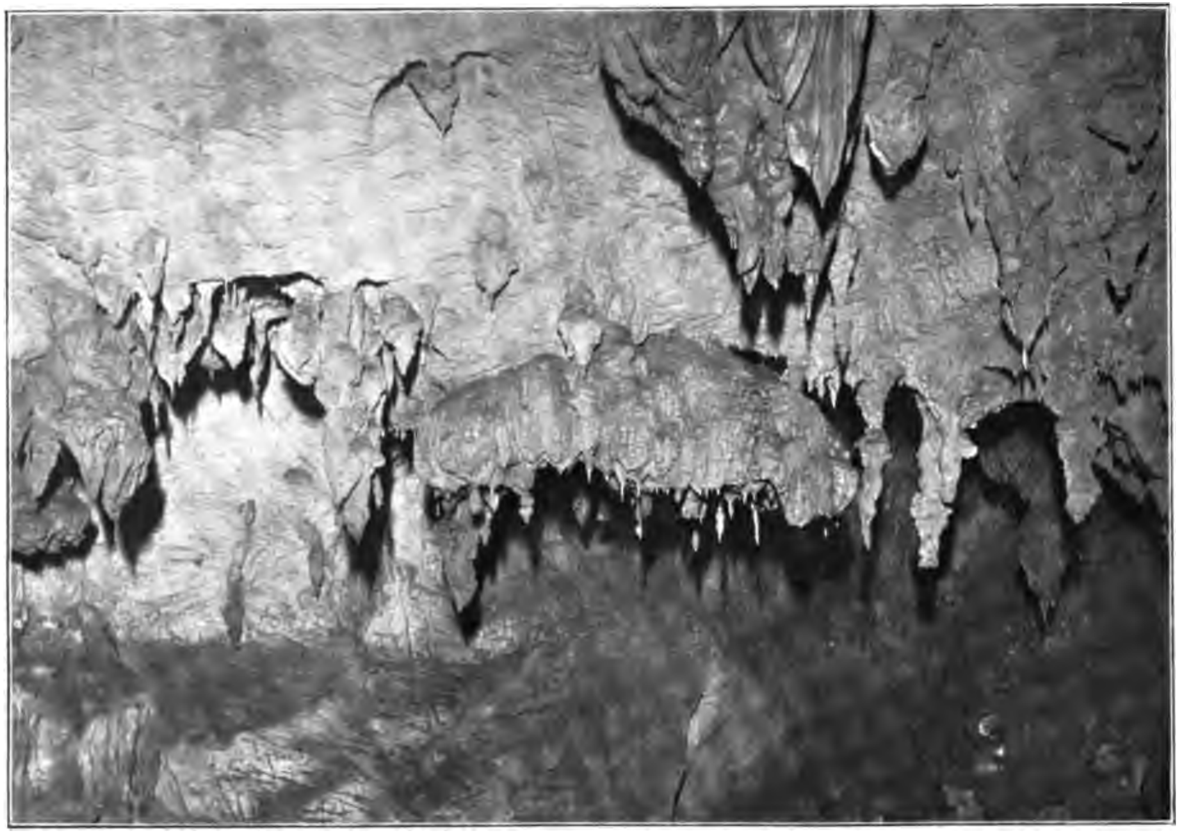
Ascending the chute above the apex of the northwest fan by the rope and ladder shown in Plate 5, a point was reached, forty-one feet above the earth floor, where a small arched cavity communicated with an earth-choked fissure leading toward the surface. Live pine roots were protruding from the clay filling the fissure. On the hillside above, a depression in the limestone, filled with yellow earth and supporting a vigorous growth of brush and one or two young pine trees, may represent the continuation of the fissure toward the surface.

Above the apex of the southeast fan a vertical chimney sub-divides into several openings too small to follow. Leading off from this chimney, a deep pocket-like hole was found, containing a large number of bones imbedded in a highly calcareous earthy matrix. A sheet of stalagmite covered the surface of both fans along the western side of the chamber. Four prominent rock masses rose above the even slope of the floor. The largest of these was in the form of an altar resting upon a base of crystalline stalagmite. Above the altar, a great stalactite hung from the roof (Pls. 1, 6 and 14). Two broad benches of white calcite, rising above the floor, were overlapped by the stalagmite sheet (Pl. 14, Nos. 10, 11). A large fallen block, fringed with pendants and partly imbedded in the surface stalagmite and clay, lay against one of the benches (Pl. 14, No. 8). A record of Mr. Richardson's visit was found on this block, together with the names of several other visitors. Loose blocks of limestone were scattered over the surface of both slopes, especially that in the southeast end. Bat excrement had accumulated over a part of the floor, reaching a depth of a foot and a half along the east wall. It was in the stalagmite floor of this chamber that the bones collected by Mr. Richardson were found.

METHOD OF WORKING.

Work was begun in the clay about the middle of the main chamber near the margin of the northwest fan, and was carried toward the northwest end. Later, the excavation of the southeast fan was completed. The surfaces of the slopes were staked out in four-foot squares and each of these was worked in ten-inch levels, all the specimens from each section being labeled with the

The cave mouth. The outer chamber mentioned in the text is at the top of the ladder.



Stalactites on the west wall, main chamber.

number of the section and the depth at which they were found. The corner stakes of some of these sections are shown in Plate 6. Much of the material composing the southeast fan was firmly cemented with stalagmite, requiring the use of powder to loosen it, and it was worked by slicing from a vertical face instead of by excavating individual squares horizontally as elsewhere (Pl. 6). Particular attention was given to preventing specimens from a higher level rolling down and becoming confused with bones from a greater depth. The loose earth was sorted with a trowel and removed after each shot. A somewhat similar method was followed in blasting out the lower stalagmite layers. The soft clay beneath was removed and the portions undermined were shot out. The large blocks of cemented clay dislodged by the blasts were carefully broken, and the pieces were examined individually. As excavation advanced the material examined was shoveled back over the worked area.

STRATIGRAPHY OF THE NORTHWEST FAN.

The structure of the fan in the northwest end was found to be as follows in descending order:

A. Clay with gravel lenses, greatest depth 13½ feet.
B. Persistent gravel stratum, 6 inches to 1½ feet.
C. Volcanic ash, 0 to 1½ feet.
D. Clay with fallen limestone blocks, 0 to 3 feet.
E. Clay and gravel cemented with stalagmite (false floor), 6 inches to 2½ feet.
F. Soft clay, maximum thickness 4 feet.
G. Stalagmite blocks in clay matrix, greatest depth not determined.
H. Stalagmite bosses—cave floor.

The clay of stratum A was similar to the surface soil on the hillside above the cave. It was of a dull yellow color approaching red when wet, and contained abundant angular fragments of blue limestone and occasional pieces of stalactite from the roof. The layer of stalagmite capping the clay on the west margin rarely exceeded a few inches in thickness, usually averaging from half an inch to an inch. It was largely deposited by water dripping from the pendants fringing the west wall.

Within the limits of stratum A were two lenticular sheets of gravel, which terminated abruptly toward the southeast against a large boss of crystalline calcite probably forming part of the original cave floor. (Pl. 12, Sec. 7.) These gravel layers were similar to the larger and more persistent stratum B. All three roughly paralleled the surface of the fan, and thinned out toward the northwest. They were composed of angular, drip-worn fragments of limestone, and seem to have been formed by water falling from the roof and washing the small limestone fragments from the clay. Along the west wall, the gravel strata were in some places found to coincide with sheets of stalagmite. This would indicate that the gravel layers like the stalagmite were formed during halts in the accumulation of the cave deposit. The gravel layers were separated by sheets of clay similar in every respect to the first clay stratum described. On the disappearance of the gravel all these clay strata blend. This is shown in the cross section (Pl. 12), and accounts for the great thickness of stratum A. It is evident from the section (Pl. 12, Sec. 7) that the lower layers of this stratum are older than those above, but it was not possible to separate them beyond the limits of the gravel layers.

The ash layer, stratum C, was composed of fine particles of volcanic glass. It was thin-bedded throughout, indicating deposition in a small pool of standing water. The deposit attained a thickness of a foot and a half toward the center, thinning out at the northwest and southeast margins. The purest samples of the glass are of a pale straw color, and under the microscope appear as fine filaments with vitreous luster. Between crossed nicols they remain dark for all positions of the field. That a part of the ash stratum lying toward the center of the deposit was a deeper ochreous yellow is due, probably, to the presence of limonite leached in from the beds above. The leaching in of lime and iron from the overlying clays has not affected the glass, which is perfectly fresh.

The ash shows little mixture with foreign material, indicating very perfect assorting by the winds which transported it into the cave, and rapid deposition in the pool which then lay on the cave floor. Scattered through the ash there are small black or

Apex of the northwest fan. The vertical chute rises above the ladder.

dark brown grains of doubtful nature, which may represent decomposed rock or mineral particles erupted with the ash.

The stratum lay in general flat, but at the northwest margin it had a dip of about five degrees toward the southeast due to the deposition of the margin of the sheet over the sloping surface of the clay beneath it.

The source of the ash is unknown. It was probably produced by an explosive eruption of some one of the numerous volcanic peaks to the north or east. Apart from the remnant preserved in the cave, no trace of this ash has been found. It must have been deposited widely over the surface of the country, but the thin layer of incoherent material was readily removed during the period of erosion which followed the accumulation of the cave deposit.

Stratum D was similar to the clay composing the upper layers of stratum A, from which it could not be separated beyond the limits of the ash. It contained a considerable number of limestone boulders and was more or less hardened by stalagmitic material.

Excavation ceased during the season of 1902 at the so-called false floor, stratum E, a sheet of cave breccia too hard to penetrate without blasting. The greater part of the floor was removed during the past summer, when it was found to be composed of layers of yellow clay with numerous limestone fragments, the whole cemented by stalagmite into a compact mass.

Lying beneath the false floor was a deposit of soft yellow clay, stratum F, reaching at its maximum a thickness of four feet. The clay was not a constant feature beneath the floor, disappearing toward the southeast, where stratum E rested on bosses of stalagmite.

Stratum G, lying beneath the clay, was composed of large loose blocks of yellow calcite in a clay matrix. Locally the clay was more or less hardened by the infiltration of calcareous material. Filling what appeared to be deep basins in the limestone floor, and occasionally occurring between the loose blocks, was a soft chocolate-colored mud showing stratification planes and evidently deposited in pools of water. The greatest depth of this formation was not determined.

Excavation ceased when great masses of white stalagmite were encountered. These growths did not form a sheet, but were highly irregular, rising as rounded bosses with deep depressions between. They are prolongations of the inward slopes of the cave walls, which are covered with a similar accumulation of stalagmite, and formed the rock floor on which the layers of clay, ash, and gravel were accumulated.

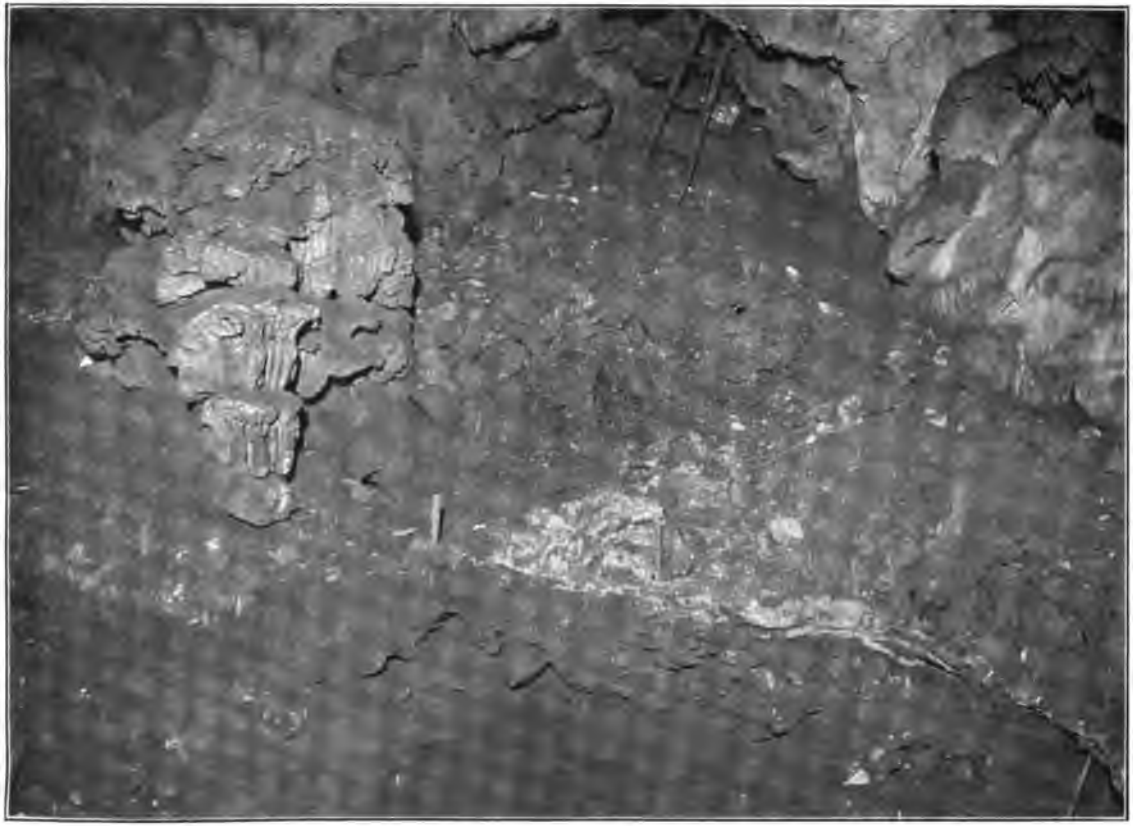
STRATIGRAPHY OF SOUTHEAST FAN.

The southeast fan was much simpler in structure, possessing none of the variety of stratified deposits found in the middle of the main chamber. The entire deposit in this end of the cave resembled in material and structure the cemented breccia layer, stratum E, of the northwest fan. It was composed of sheets of clay containing a large number of rock fragments of all sizes. Clay and rock were firmly cemented by stalagmite into a hard breccia. Lenses of soft earth occurred, irregularly distributed through the breccia. Often the deposit was quite soft along the cave walls. The soft and hard layers bore no definite relationship to each other either in stratigraphic sequence or areal extent, and frequently passed abruptly from hard to soft. The rocks imbedded in the clay and breccia were either angular masses of blue limestone or more or less rounded calcite bosses similar to the altar base. The calcite bosses seemed to have fallen from above rather than to have formed in place, as the clay was often soft on all sides of them. In the section (Pl. 12) the entire deposit in this end of the cave has been referred to stratum A.

Wherever the rock floor was struck beneath the southeast fan, it was found to be similar to that described for the opposite end of the cave.

BURIED GALLERIES.

During the excavation of the northwest fan there was discovered a series of chambers not before visible. The opening leading to these chambers (Pl. 11, I; Pl. 13, Fig. 5, I) was in the west wall of the main cave and was buried beneath about eleven feet of stratified deposits. The principal gallery had a length of forty-two feet extending parallel with the trend of the main room of the cave. At its northwest end it was prolonged by a low



Apex of the southeast fan. The vertical face developed by blasting is shown beneath the line of stakes in the foreground.

narrow tunnel, eleven feet in length. Joining the main gallery on the west was a semi-circular passage, the floor of which was of blue limestone, but some earth and a few bones had found their way into it.

Flooring the long straight gallery was a mass of cave earth derived from the deposit in the large room. The top of this earth mass represented the continuation of the upper surface of the false floor (Pl. 11). From this point the surface sloped downward steeply toward the northwest. The surface was covered with a creamy white stalagmite varying in thickness from a thin shell up to three or four inches. A small amount of soft earth filled the entrance above the level of the false floor. Within the entrance stratum E could no longer be distinguished, but is probably represented in part by the stalagmite layer. The earth deposit in this tunnel was soft above, but hardened into breccia as the rock floor was approached. Extending at least half way down the slope, beneath the clay, was a sheet of crystalline stalagmite a foot or more in thickness. This was a prolongation of the mass shown at H in Section 5, Plate 13. Beneath the stalagmite the chocolate-colored mud was present to a depth of more than three feet.

POCKET DEPOSITS.

In the east wall of the main cave there is a small tunnel opposite the altar and about twelve feet above the floor. From an entrance of irregular shape it runs downward for about fifteen feet. This hole contained a small amount of earth and a number of rather poorly preserved bones. A much larger tunnel opened from the chute at the southeast end of the cave. This hole was six or seven feet in diameter and descended vertically. It also contained earth and bones which appeared to have found their way in through a narrow vertical opening extending toward the surface. This bone-bearing deposit was worked to a depth of nine feet when the increasing difficulty of handling the excavated material and the want of proper facilities for ventilating the narrow shaft compelled a cessation of the work. The earth in both these pockets was highly calcareous, due to the softening and sloughing off of stalagmitic material covering the walls of

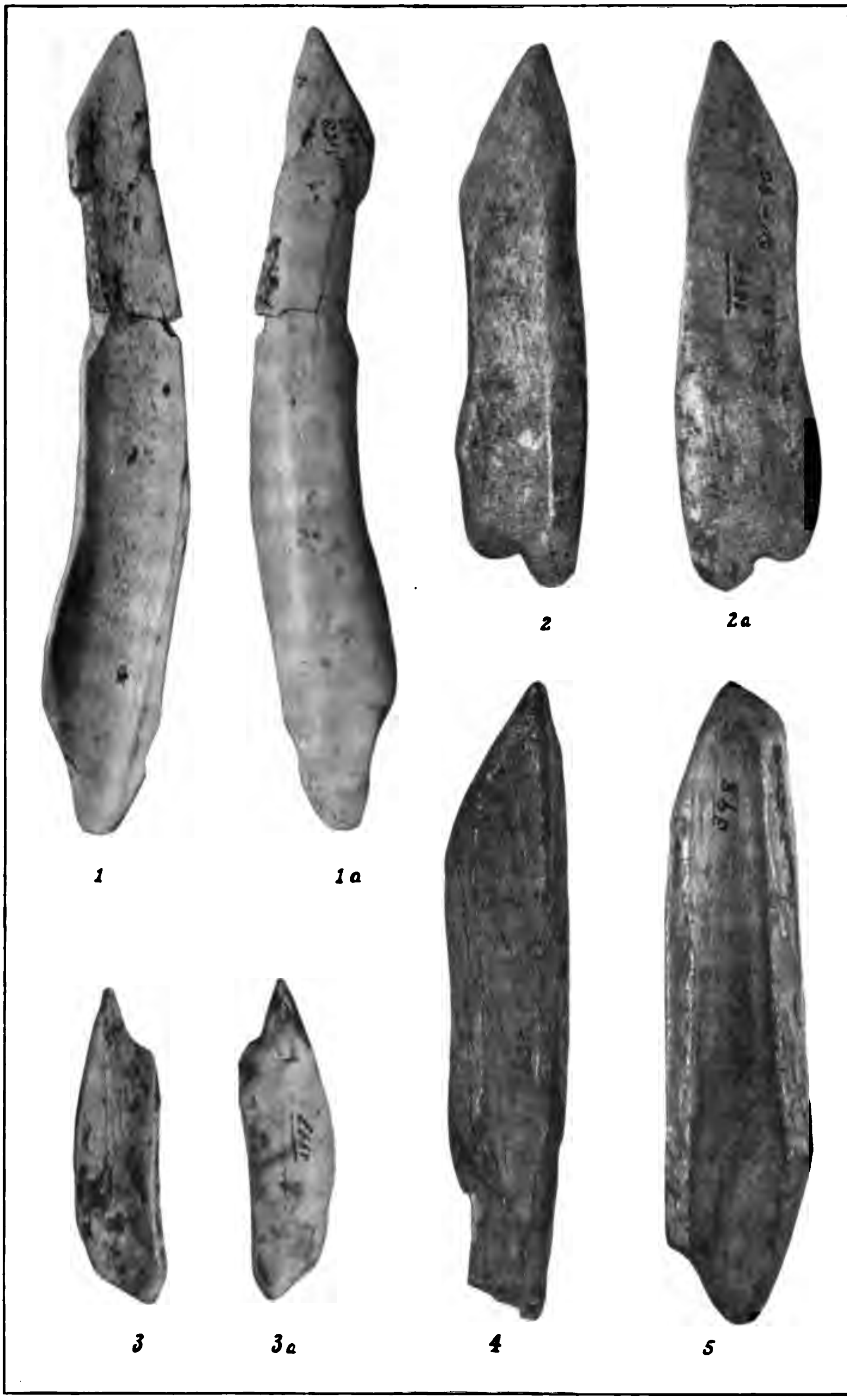
tions. Those from the superficial layers of stratum A are often blackened.

It is difficult to see how such a variety of animal remains could accumulate in the cave, as the number of individuals of the larger forms represented by dissociated parts is considerable. There is little definite evidence indicating that *Arctotherium* lived in any of the existing galleries, and, as it could not easily have climed into the chamber where its remains were found, it is possible that it fell in, but not necessarily by way of the present entrance. There is nothing to indicate that a catastrophic event destroyed large numbers of animals in this vicinity. The cave seems to have remained open for a long time, receiving bones swept in by rills during wet weather, and the remains of such forms as accidentally fell in. It is possible that the *Arctotherium* inhabited a den adjoining the large chamber, and that from this bones found their way into the cave. The edges of some of the larger bone fragments are flaked off in such a manner as to suggest that they might have been broken by the powerful teeth of this great carnivore. No trace of such a den can now be found, owing to later erosion which dissected the surface of the region.

Relics of Possible Human Origin.

Human remains and implements were carefully sought during the whole course of excavation in the Potter Creek cave. During the first season's exploration several polished bones were found which bear a striking resemblance to rude implements. Three typical specimens are represented, natural size, on Plate 7. The largest of these, No. M3982 (Figs. 1, 1*a*) is pointed at both ends, with indications of beveling at one extremity. The whole fragment is polished. The second specimen, No. M3894 (Figs. 2 and 2*a*), has the edges on either side of the point beveled and polished, and shows a distinct notch in the broad end. The remaining edges are rounded and polished. This specimen was found embedded in soft clay between eighty and ninety inches beneath the surface. In an adjacent section several teeth of an extinct ungulate, *Euceratherium collinum*,* were

* See foot-note on p. 18.



Figs. 1–3*a*. Implement like bone fragments from the Potter Creek Cave (Natural size).
Figs. 1, 1*a*, No. 3982, Sec. 20, 130–140 inches beneath surface; Figs. 2, 2*a*, No. 3861, Sec. 33, 80–90 inches beneath surface; Figs. 3, 3*a*, No. 3997, Sec. 7, 80–100 inches beneath surface.
Figs. 4, 5. Bone implements from the Emeryville Shell Mound (Natural size).

found at a level six feet above the implement-like piece of bone The considerable depth at which the specimen was found in undisturbed earth and the presence of remains of an extinct species above it, indicate that it is not of recent origin. The third specimen, No. M3997 (Figs. 3 and 3*a*), is sharply pointed at one end, both surfaces are polished and the edges rounded. These polished bones closely resemble many of the rough implements from the shell mounds of California. Figures of two of these implements, reproduced from the plates accompanying the manuscript of Dr. Max Uhle's report on the exploration of the shell mound at Emeryville, are given on Plate 7, Figures 4 and 5. Dr. Uhle believes that these implements were originally splinters accidentally formed in breaking up long bones. Favorable pieces were selected because they had sharp points and these were polished in use. Often the point has been beveled by rubbing on one side.

To eliminate as far as possible all question regarding the nature and origin of these polished bones, every fragment encountered during the excavation was preserved. These were carefully examined in the laboratory for traces of polish and any indication of cutting or rubbing to form a point or beveled edge. The result has been that a considerable number of specimens were found showing all degrees of polish associated with much variety of form. Some of these fragments bear no relation to any known form of implement and it is not easy to see how they could have been used. Many gradations exist between the irregular polished fragments and the implement-like specimens. This suggests the idea that they have all been made in some other way than through the agency of man, and that the rough, implement-like form is purely a chance occurrence. It is therefore important to inquire whether the wear and polish could have been produced by natural means. In one or two instances polished fragments were found associated with limestone gravel in small rock-rimmed basins, where they had been exposed to the action of dripping water. The association of polished bones with drip-washed gravel suggests that some of the worn bones found in the clay may have been abraded in pot holes by this means, or by rill action, before they were entombed.

While the explanation just given may readily apply to the irregularly-shaped polished fragments, the beveled edges and notched base of the specimen shown in Figure 2 convey a very strong impression of definite purpose controlling its fashioning. On the other hand, the writer does not feel justified in positively asserting the human origin of this relic, believing that we require stronger evidence than it has yet been possible to obtain before such a statement is made.

A large part of the material collected consists of sharp-edged bone splinters. These are found at all depths in the bone-bearing deposits, and in all parts of the cave. Many of the splinters occur low down in the deposits and are associated with remains of numerous extinct animals. They resemble the fractured bones from the shell mounds along the coast. We can conceive of these splinters having been formed in a number of ways. They might have been produced by large bone-crushing carnivores, but well-marked traces of gnawing, excepting those referable to rodents, have not been observed on these fragments. In some cases, bones may have been fractured by the impact of their dropping into the cave, or by heavy stones crushing down upon them, but these explanations can not account for the presence of the large number of sharp-edged splinters found, without having some very definite evidence in their support, and this has been obtained in only a few cases. Fractured bones were found near the entrance in the upper gallery, where the distance from the surface is small. Again, bones may have been broken by striking against the irregular walls of the chutes, through which much of the cave earth entered. Regarding this, it may be said that fragile bones were often recovered entire, while most of the splinters were produced from the fracture of large limb bones. Furthermore, the percentage of abraded specimens is much smaller than would be required by this theory, as most of the splinters still have sharp edges.

Another possible explanation is that they were produced on the surface of the ground outside the cave by the process of weather cracking. Only a few could have been formed in this way, and they would in the majority of cases have the edges rubbed down in the process of being carried into the cave.

Since other suggestions fail to explain the presence of these

splinters satisfactorily, it is not beyond the limits of possibility to suppose that they were made through the agency of man. In the case of the material from the shell mounds, the bones were broken to extract the marrow by pounding with a heavy stone, resulting in the production of splinters identical in character with those from the cave. A difficult point to explain by this hypothesis is the presence of these fragments in all manner of inaccessible places, as in the pocket in the east wall, where they could not have been thrown, and must have been carried down through narrow rock channels now closed by stalagmitic growths. Possibly they were washed in from a refuse heap or the accumulation in a rock shelter. The uncertainty of the evidence must be advanced in this case also. At the present time no explanation of the origin of the fragments has been discovered which accords with all the observed facts, though the suggestion that they were made by man appears on the evidence of occurrence to be open to the fewest objections.

In the clay flooring the passage leading back to the top of the swinging ladder, a sharp-edged stone chip, flaked from a river-worn pebble, was found associated with the charcoal mentioned as occurring in the clay. A *Margaritana* shell, several bone fragments, a tooth of the large ungulate, *Euceratherium*, and a fragment of a mammoth tooth were associated with the stone chip. The charcoal did not occur as a definite stratum, but was scattered in small fragments through a fine clay from six inches to eighteen inches beneath the surface of the floor of the gallery. It seems to have accumulated with clays which were carried in from the surface by rain water percolating through fissures in the limestone. It can hardly be considered as certainly representing a local hearth deposit, though such may be the case. It is also possible that it is the result of Quaternary forest fires and has been washed into the cave.

A careful study of the cave collection has failed to indicate the presence of human bones. Early man might have been in existence in the region and yet his remains have escaped preservation in the cave. Those chambers in which the ossiferous deposit attained its maximum accumulation may not have been easily accessible to man or may have been so far from the entrance

that he would have preferred not to visit them frequently. A fragment of modern Indian basket work was found on the surface near the top of the ladder seen in Plate 3, indicating that the entrance chambers may have been used occasionally in recent years as a place of storage. There was nothing to indicate that they had been so used in prehistoric times. It seems probable that the main chamber of the cave originally had free communication with the surface, serving as a pitfall to catch unwary mammals. The accumulation of human remains in such a pitfall would be of rare occurrence, depending upon accidents against which the superior intelligence of man would protect him.

The cave fauna is not too old to negative the idea of contemporaneity with man. There can be little doubt that if man reached the North American continent during the Quaternary it was by way of the land bridge which then united Alaska with Siberia at Bering Strait. This land connection permitted the migration of many of the mammals now common to the most northern parts of both continents.* It seems reasonable to expect that some of the earliest traces of man in North America would be found on the Pacific coast where the climate was congenial and food supply abundant while the eastern portion of the continent was submerged beneath the ice sheet. Glaciation in California has never been general, occurring only at the higher altitudes. At its maximum the coast was almost as well adapted to human habitation as it is to-day.

THE CAVE FAUNA.

With the exception of bats, no vertebrates are living in the perpetually darkened portion of the cave. A few wood-rats have nested in some of the holes in the cliff above the entrance. Cliff-nesting birds (swallows and wrens) occupy some of the narrow ledges and smaller holes. An occasional rattlesnake may be found in the brush and loose stones about the cave mouth. Several white isopods and a number of spiders were collected in the main chamber of the cave. These were submitted to Professor C. A. Kofoid. The isopods, Professor Kofoid states, are closely allied to *Procellio scaber*, a cosmopolitan species.

*R. Lydekker. "A Geographical History of Mammals," p. 337, pp. 346–348.

The spiders belong to an undetermined species in which external eyes are not apparent. They were living on webs spread in crevices in the cave walls and on the altar in the southeast end. In addition to these, an earthworm and several beetle larvae were found in the damp earth on the floor. A few specimens of a large myriapod were noticed, and encrusted fossil remains of an allied form were occasionally found in the breccia and gravel layers.

The following is a revised† list of the vertebrate species represented by remains collected in various parts of the cave. All extinct species are marked with an asterisk:

***Arctotherium simum* Cope.
***Ursus* n. sp.
***Felis* n. sp.
Felis near *hippolestes* Merriam, C.H.
Lynx fasciatus Rafinesque.
Lynx fasciatus n. subsp. (?)
Urocyon townsendi Merriam, C.H.
Vulpes cascadensis Merriam, C.H.
***Canis indianensis* Leidy.
***Taxidea* n. sp. (?)
Bassariscus raptor Baird.
Mephitis occidentalis Baird.
***Spilogale* n. sp.
Putorius arizonensis Mearns.
Arctomys sp.
Sciurus hudsonicus albolimbatus Allen.
Sciuropterus klamathensis Merriam, C.H.
Spermophilus douglasi Richardson.
Eutamias senex (?) Allen.
Callospermophilus chrysodeirus Merriam, C.H.
Lepus californicus Gray.
Lepus klamathensis Merriam, C.H.
Lepus near *audoboni* Baird.
Lepus sp.
***Teonoma* n. sp.
Neotoma fuscipes Baird.
Microtus californicus Peale.
***Thomomys* n. sp.
Thomomys leucodon Merriam, C.H.
Thomomys monticola Allen.
***Aplodontia major* n. subsp.
Scapanus californicus (?) Ayres.
Antrozous pallidus pacificus Merriam, C.H.

† Provisional list in Science, N.S., Vol. XVII., No. 435, pp. 708–712, May 1, 1903.
* Extinct.

**Platygonus* (?) sp.
Odocoileus sp. a.
Odocoileus sp. b.
Haplocerus montanus Ord.
**Euceratherium collinum* n. gen. and sp.†
**Bison* sp.
*Camelid
**Megalonyx wheatleyi* (?) Cope.
**Megalonyx jeffersonii* (?) Harlan.
**Megalonyx* n. sp.
**Megalonyx* sp.
**Mastodon americanus* Kerr.
**Elephas primigenius* Blumb.
**Equus occidentalis* Leidy.
**Equus pacificus* Leidy.
Crotalus sp.
Mylopharodon conocephalus Baird and Gerard.
Ptychocheilus (?) *grandis* (?) (Ayres).
Acipenser medirostris (?) Ayres.

In addition to the species listed, there should be mentioned a large number of birds which have not been determined, and

* Extinct.

† This form is being investigated jointly by Mr. E. L. Furlong and the writer. The following preliminary description is abstracted from their manuscript:

Euceratherium collinum n. gen. and sp.

Type.—No. M8751 Univ. of Cal. Palaeontological Museum. A cranium without mandible discovered by Mr. E. L. Furlong in the Samwel cave, Shasta Co., Calif.

Generic Characters.—Horn-cores solid, situated far behind orbit, close together on posterior extremity of frontal. Frontal reaching occiput, with large pneumatic cavities extending into bases of horn-cores. Parietal confined to occiput, forming no part of cranial roof. Lachrymal pit broad and shallow. Dental formula $\frac{0}{-}, \frac{0}{-}, \frac{3}{-}, \frac{3}{-}$. Teeth hypsodont, large, without cement or accessory cuspules.

Specific Characters.—Horn-cores laterally compressed and curved, elliptical in cross section at base, circular at tip. Proximal half directed upward and backward, distal half outward and forward. Frontals broadly convex above orbits, slightly inflated toward bases of horn-cores. Occiput with sharp median keel above foramen magnum. Size almost equal to that of *Bos*.

Systematic Position and Relationships.—The new genus is a member of the cavicorn division of Artiodactyla. It combines characters of several groups. From the Bovinae it is separated by the lack of cement and absence of accessory cuspules on the teeth. It differs from the goats in possessing a lachrymal depression. The shape and position of the horn-cores, and the large size of the animal separate it from *Ovis*. It is larger than any of the so-called goat-antelopes of North America, and differs from them in the presence of a lachrymal depression, the conformation of the parietal zone, and the shape and position of the horn-cores. On the other hand, it resembles the Bovinae in size, in the posterior position of the horn-cores, and in the relations of the frontal and parietal, but differs from that group in the possession of a lachrymal pit, and in dental structure. The teeth approximate in size and structure those of *Ovibos*, but there are marked cranial differences which separate *Euceratherium* from that genus. E. L. FURLONG and WM. J. SINCLAIR.

a tortoise. Shells of the helicoid mollusc *Epiphragmophora mormonum* were common, as were also remains of a fresh-water mussel allied to *Margaritana falcata* living in the McCloud river. The fresh-water molluscs and the fishes are believed to have been transported by birds.

Of the fifty-two species listed, twenty-one are extinct and two or three in addition doubtfully so.* All the large ungulates and carnivores are extinct, while of the surviving forms the rodents comprise the major portion. Associated with mountain and forest types like *Haplocerus* and the deer are plains species, the horses, camel, bison and elephant. The fauna listed is a unit. No distinction is to be drawn between the collections from the different layers. Several living forms which were not known to date back beyond the recent epoch have been found. Among these may be mentioned the Aplodontidae, the so-called Rocky Mountain goat, *Haplocerus*, and the rattlesnake, *Crotalus*. With the exception of a single individual from Mercer's cave, Calaveras County, ground sloths of the genus *Megalonyx* have been found for the first time in this state, while *Mylodon*, a contemporary of *Megalonyx* in California, is not represented. The types present, as well as the proportion of living to extinct species, indicate that we are dealing with an assemblage of forms of later Quaternary age.

THE CONTEMPORARY FAUNA.

The San Pablo Bay Quaternary.—On the east shore of San Pablo Bay, north of Pinole, there are marine beds resting on the upturned edges of the San Pablo. One stratum is composed largely of oyster shells. Dr. Ralph Arnold has collected from these beds *Ostrea lurida*, *Ostrea conchaphila*, *Mytilus edulis*, and *Tagelus californicus*. On the basis of the character of the strata and their fauna, Dr. Arnold has correlated these beds with the Upper San Pedro series.†

Above the shell beds are alluvial deposits of sand, clay and gravel which have afforded bones of various extinct mammals. Remains of *Elephas* have been found in the shell stratum beneath

*A doubtful sub-species of *Lynx fasciatus*, a *Lepus* and a species of *Odocoileus* may be extinct.

†Memoirs Cal. Acad. Nat. Sci. Vol. III, p. 49.

the alluvium. Including this specimen with the species from the alluvial deposits, the list of vertebrates from this locality is as follows:

Large carnivore genus and sp. indet.
Camelid.
Morotherium gigas Marsh.*
Bison antiquus Leidy.
Elephas primigenius Blumb.
Mastodon americanus Kerr.
Equus pacificus Leidy.
Equus sp.†

This is a plains fauna, and a comparison of it with the cave fauna should be confined to the plains species from the latter, as the bay region during the accumulation of these alluvial deposits was probably not adapted to forest types. With this limitation in mind, the two faunas are seen to be practically the same. From the sequence of Quaternary geological events which Professor Lawson has worked out for the bay region, the beds at Pinole are known to belong probably to the last quarter of that period.‡ This evidence combined with that derived from a study of the mammalian fauna indicates with considerable certainty that they are of the same age as the cave deposit.

The Fauna of the Silver Lake Beds of Oregon.—In order to fix the age of the cave deposit as definitely as possible, comparison may be made with the fossiliferous deposits at Silver Lake in Southern Oregon. The age of these beds is determined by the relation of their mammalian fauna to the faunas characterizing an extensive series of Miocene, Pliocene and Quaternary deposits in the John Day region. The following list of species from this locality is compiled from lists furnished in the manuscript of a paper on the "Fauna of Silver Lake" by Dr. Alice Robertson and from a paper entitled "List of the Pleistocene Fauna from Hay Springs, Nebraska" by Dr. W. D. Matthew.§

Ursus sp. indet.
Felis sp. indet.

* From Tomales Bay and Bull's Head Point, Contra Costa County. Quaternary, same beds as those at Pinole. Merriam, J. C., Bull. G. S. A. Vol. XI, pp. 612–614.

† Smaller than *E. pacificus*, but with more complex tooth pattern than *E. occidentalis*.

‡ Communicated.

§ Bull. Am. Mus. Vol. XVI, pp. 317–322.

Canis latrans Say.
Canis cf. *occidentalis*, Richardson.
Vulpes cf. *pennsylvanicus*, Rhoads.
Lutra canadensis Schreber.
Fiber zibethicus Linnaeus.
Arvicola sp. div.
Thomomys sp.
Geomys sp.
Castor sp.
Castoroides sp.
Lepus sp. (cf. *campestris* Bachman).
Mylodon sodalis Cope (? *M. harlani* Owen).
Equus pacificus Leidy.
Equus n. sp.*
Elephas primigenius? columbi Falconer.
Platygonus, cf. *vetus* Leidy.
Platygonus sp. minor.
Eschatius conidens Cope.
Camelops kansanus Leidy.
Camelops vitakerianus Cope.
Camelops? sp. max.
Antilocapra.

Regarding this association of species Dr. Matthew writes: †

"This is equally a plains fauna, with two aquatic mammals, *Castor* and *Lutra*, not found at Hay Springs. Otherwise the list is very similar to that at Hay Springs, and, like it, is characterized by the absence of the forest types found in the Pleistocene cave deposits, river gravels, and peat bogs of the East."

The list contains several species not found in the cave, among which may be mentioned *Lutra*, *Fiber*, *Geomys*, *Castor*, *Castoroides*, *Antilocapra* and the coyote. Horse, camel and elephant bones make up the greater part of the Silver Lake collections, while the remaining forms are represented by fewer individuals, in some cases by one or two specimens only. In the cave material, there are scores of specimens of *Arctotherium*, *Ursus*, deer, *Euceratherium* and various rodents, while of such plains types as *Elephas*, *Equus* and the camels a few fragmentary teeth were found. *Megalonyx*, which in California seems to have preferred the foot-hill region of the Sierra Nevada and the Klamath Moun-

* Podial elements of an equine very much smaller than *E. pacificus*. The remains are regarded by Dr. Robertson as those of an adult individual.

† loc. cit., p, 321.

tains is replaced in the Oregon plains fauna by the contemporary *Mylodon*.

The Silver Lake fauna is Quaternary and is probably of about the same age as the cave deposit, as the proportion of living to extinct species is practically the same. *Equus pacificus* and *Elephas primigenius* are common to the cave, the beds at Pinole and the Silver Lake locality. Several additional genera are common to the Silver Lake beds and the cave, but there are a number of species, mostly living forms, represented in the Oregon fauna which have not been found in the cave. Some of these differences may be accounted for by the topographic dissimilarity of the two regions and their separation by considerable mountainous areas.

Relation of the Cave to the Existing Topography.

The spur on which the cave lies (Pls. 8 and 9) is one of several westerly and southwesterly trending ridges carved out of the Baird formation and the McCloud limestone, by short streams emptying into the McCloud River. The ridges form divides between cañons with steep slopes. Where they are not controlled by the limestone outcrop, they rise gradually from the 1500-foot contour toward Horse Mountain (4040 ft.). Below the 1500-foot line, the slopes fall off rather abruptly toward the river. The surface from the cave to the mouth of Potter Creek has a fall of 800 feet in about one and one eighth miles.

On the west side of the river, back of Baird, the topography is less rugged. The break below the 1500-foot contour is also better marked (Pl. 10). The stream cañons are fairly deep where they cut through the Baird shales, but broaden out at their head waters on Johns Creek and Turntable Creek.

The creeks coming in from both sides reach the McCloud at the low water level of that stream, but this grade does not extend far up the tributaries, which have a fairly steep slope and are still cutting vigorously.

On both sides of the river water-worn pebbles are abundant up to a level of 1500 feet above sea. These are found on the crests of divides between streams, on cañon slopes and on isolated summits.

Entrance to the cave. Looking northwest across the cañon of Potter Creek.

Looking northeast across the McCloud cañon from the south side of Turntable Creek. The cave lies on the lower limestone ridge indicated by the arrow.

RELATION OF THE CAVE TO THE QUATERNARY TOPOGRAPHY.

The 1500-foot contour marks approximately the present elevation of an earlier valley stage beneath which the existing cañons are trenched. This topographic feature is not particularly well developed in the vicinity of the cave, owing to the excessive amount of stream dissection which the region has suffered. Mr. J. S. Diller has informed the writer that it is well shown in the vicinity of Kennett. It is also developed to the east and northeast of Bear Mountain, and may be viewed to advantage from the high ridge on the south side of Potter Creek. In Plate 10 the trace of this earlier valley surface is shown on the summit of the flat-topped hill in the background. River-worn gravel was found on the top of this hill and also strews the slopes to the back of the terrace shown in the middle ground.

At the time when the cave deposit was accumulating the McCloud River flowed at a level not much lower than the bottom of the cave, or not far below the 1500-foot contour. This level was maintained not only during the time of accumulation, but during the much longer preceding interval required for the removal by solution and otherwise of a mass of limestone equal in volume to the cave. This could not have been accomplished with the river at a higher level, as in that case there would be no exit for the underground water, which would tend to stand in the country rock under pressure rather than to assume a single direction of flow along the fissure line controlling the trend of the cave. The shape of the cave, wide above and narrowing downward, shows that the point of discharge for the percolating waters must have been at a level lower than the present entrance.

As the tributary streams extended back by headwater erosion, the country on either side of the cave was better drained. Less rain water circulated along the fissure and cave cutting ceased, because, instead of draining into the cave by a sink, the water flowed into the creeks. At this stage the large calcite bosses on the floor were formed. Later, openings in the roof, probably formed by rills washing off some of the surface material on the slopes of the incipient cañons of Potter and Marble Creeks, per-

mitted the entrance of clay, rock fragments, broken bones, and possibly living animals.

The mingling of plains and forest types in the Quaternary fauna is in accordance with the known moderate relief of the region, which was a broad valley with wooded hills on either side, above which rose higher peaks like Horse Mountain, affording a congenial habitat to mountain dwelling forms like *Haplocerus*, while the valley land was favorable to the presence of camels and horses.

An eruption from one of the volcanic peaks to the north or east showered the region with fine ash during this stage of topographic development, but this was a mere episode, scarcely an interruption, which did not alter the character of the fauna in the least.

This cycle of low relief was terminated by an uplift, increasing the grade of the master stream, initiating the cutting of the present McCloud cañon, and renewing headwater erosion in the lateral tributaries. Eventually one of these, Potter Creek, cut down through one of the galleries of the cave, opening the present entrance.

With the stripping off of the surface soil from the ridge sides by the deepening creeks, no more clay could enter the cave. The entrance channels were blocked by rocks or crystalline growths and the cave began to seal up its treasures by the formation of a stalagmite sheet, marking the last halt in the process of accumulation.

At first the cañon cutting was rapid, but later the river reached a lower grade and began to meander. A terrace about 240 feet above the present low water stage marks the position of the first halt. This terrace is shown on Plate 2. It is rock-cut with a thin coating of gravel on the surface. The stream gravels scattered on the cañon slopes above this level were left stranded by the McCloud as it cut down from the old 1500-foot base-level.

A second uplift, possibly of a differential character, renewed the downward cutting of the river. A second terrace, also rock-cut but of much greater extent than the first, was formed about 150 to 160 feet above the river at Baird (Pl. 10). The surface of this terrace is strewn with river gravel. A lower and much

West side of McCloud cañon, near Baird, 160-foot terrace in middle ground. The flat-topped hill in the background (elevation 1522 feet) marks the level of the earlier valley stage.

smaller terrace occurs at about ninety feet, and other less distinct levels may be traced to perhaps fifty feet above the river.*

Taking into consideration the amount of cañon cutting accomplished by the McCloud above the 240-foot terrace and comparing it with a similar degree of cutting above a certain terrace level in the cañon of the Sacramento, it seems reasonable to correlate the high terrace at Baird with the broad terrace which is so well developed in the upper end of the Sacramento Valley in the vicinity of Redding. Regarding the age of this terrace Mr. Oscar Hershey† says:

"The Red Bluff formation belongs to the last one-fourth of the Quaternary era. On the northern border of the Sacramento Valley, in Shasta County, there are flats one to two miles wide, consisting of the Red Bluff gravel resting on the truncated edges of the highly inclined metamorphic formations. They are elevated one hundred to two hundred feet above the present streams, as Clear Creek and the Sacramento River, which have trenched narrow cañons below them. The Red Bluff terrace can be traced for several miles up into the mountain valleys of such main streams as those mentioned above, and it is thus made evident that at the very least three-fourths of the erosion of the Sierran valleys had been accomplished by the time of the opening of the Red Bluff epoch."

The amount of erosion in the McCloud cañon above the upper terrace agrees favorably with Mr. Hershey's estimate, and strengthens the correlation of the high river terrace at Baird with the top portion of the Red Bluff formation, spread out over the surface of the Red Bluff terrace in the north end of the Sacramento Valley. About one-quarter of the entire interval of cañon-cutting is represented by the amount of erosion accomplished by the McCloud below the 240-foot terrace level.

The sequence of events which has been made out in the cañon of the McCloud agrees very closely with Professor Lawson's

*The terrace levels given in the writer's preliminary paper (Science N. S., Vol. XVII, No. 435, pp. 708–712) were based on roughly made observations and are not exact. The elevations given here were determined by hand level, distance from the ground to the eye of the observer being taken as a measuring rod. The measurements of the higher terraces were made twice, giving in each case approximately the same result.

† Bull. Dept. Geol. Univ. of Cal., Vol. III, No. 1, p. 12.

presentation of Quaternary history as recorded in the upper Kern basin,* but the cañon of the McCloud is not as deep as that of the Kern, owing to a lesser degree of elevation occasioning the cañon cutting. Professor Lawson's high valley zone corresponds with the earlier valley stage which has been recognized in the vicinity of the cave, beneath which the cañon of the McCloud is trenched. The trenching of the cañon occupied an exceedingly short time compared with the much longer interval required for the development of the old valley surface. The cave fauna occupied the latter during its completed stage, but was not necessarily in existence in the region while this topographic feature was being evolved.

The material excavated by the McCloud while cutting down to the upper terrace level forms a part of the great debris fan buried in the upper end of the Sacramento Valley beneath the Red Bluff terrace.

Older base levels of erosion have not been recognized in the vicinity of the cave owing to the excessive amount of dissection which the region has suffered, but a series of Tertiary peneplains in the Klamath Mountains has been described by Mr. Diller.†

The cave fauna described in the preceding pages is much older than the glacial period in this state. The maximum glaciation of the Sierra Nevada has been referred to the Wisconsin epoch of the glacial time scale worked out for the eastern part of the continent.‡ The Red Bluff epoch which has been correlated with the upper river terrace at Baird, although referable to the last quarter of the Quaternary, is older than the Californian glaciation, from which Hershey has separated it by two epochs of erosion and one of deposition.§

The Fauna in Its Relation to Topographic Changes.

The change from a country of moderate relief to a mountainous district dissected by river cañons reacted on the fauna,

* Bulletin Dept. Geol. Univ. of Cal., Vol. III, No. 15, pp. 362–368.

† "Topographic Development of the Klamath Mountains." Bul. 196, U. S. Geological Survey.

‡ O. H. Hershey. Bull. Dept. Geol. Univ. of Cal., Vol. 3, No. 1, p. 27. H. W. Turner. Proc. Cal. Acad. Sci., 3rd series, Vol. 1, No. 9, p. 270.

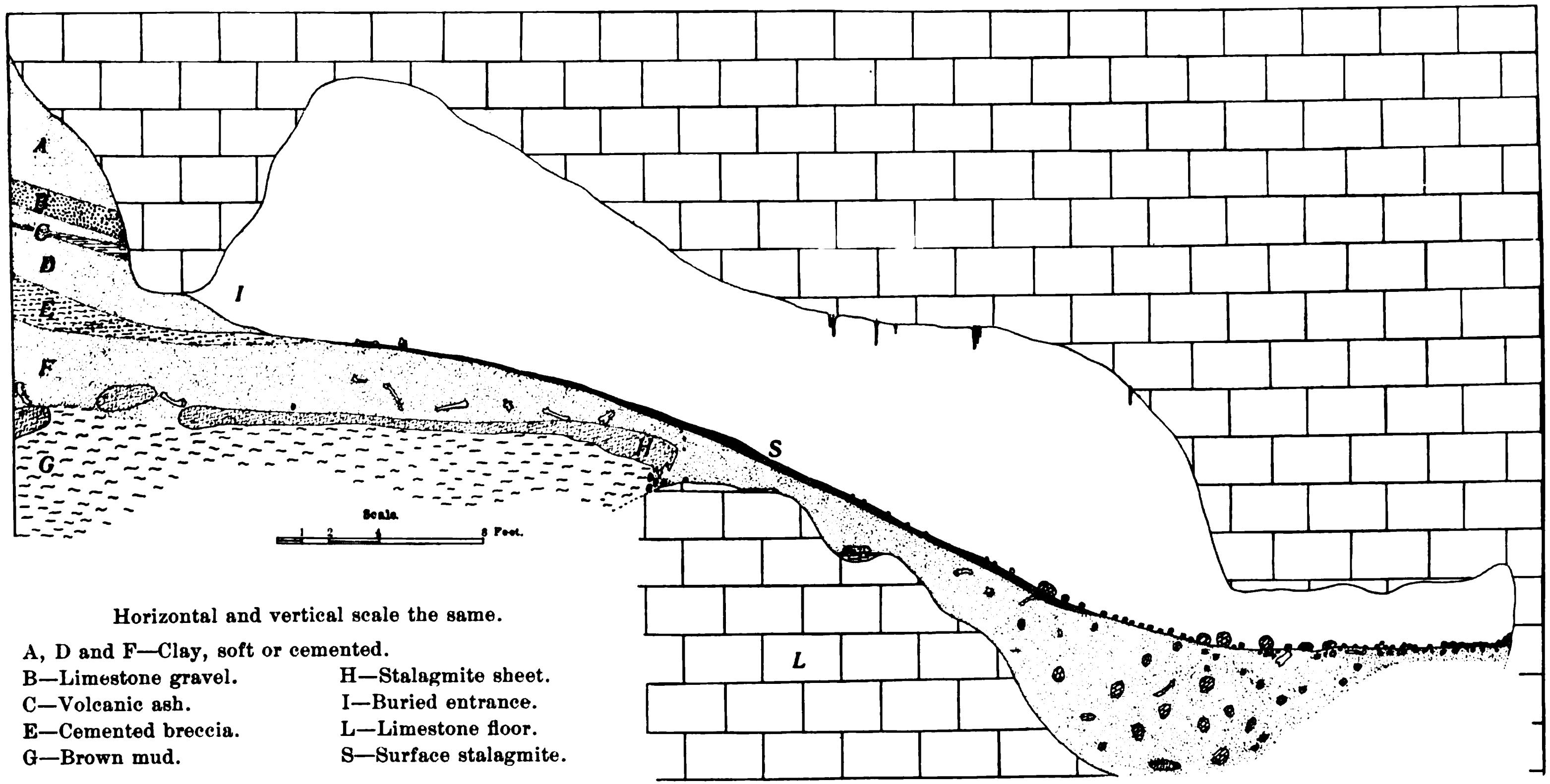
§ O. H. Hershey. Bull. Dep. Geol. Univ. of Cal. Vol. 3, No. 1, p. 28

causing migration and extinction. Those species which still exist in the region are the successful survivors, which were able to adapt themselves to the changed conditions. Some of the species which are now extinct may have continued to inhabit the region for a considerable time after the topographic revolution, but this can not be determined until bone-bearing Quaternary deposits of later age have been found. Higher up the McCloud, Mr. Furlong has discovered a cave fauna which is supposed to be younger than that described here. The study of this fauna will, it is believed, throw much light on the problem of faunal migration. The thorough examination of a series of caves ranging in age from early Quaternary to Recent will doubtless furnish valuable evidence relating to the faunal migrations, and should also give most important testimony concerning the time when man first came to inhabit this region.

University of California,
April, 1904.

EXPLANATION OF PLATE 11.

Longitudinal section of the buried gallery, showing the relation of its deposits to the beds in the main chamber of the cave.



Horizontal and vertical scale the same.

A, D and F—Clay, soft or cemented.
B—Limestone gravel.
C—Volcanic ash.
E—Cemented breccia.
G—Brown mud.
H—Stalagmite sheet.
I—Buried entrance.
L—Limestone floor.
S—Surface stalagmite.

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NEW MAMMALIA

FROM THE

QUATERNARY CAVES OF CALIFORNIA

BY

WILLIAM J. SINCLAIR.

CONTENTS.

INTRODUCTION.

The cave explorations conducted by the Department of Anthropology of the University of California have opened to the palaeontologist a new source of information regarding the Quaternary vertebrate fauna of this state. Occasional scattered teeth and bones from valley alluvium, clay beds, stream gravels and asphaltum deposits of Quaternary age occurring in various parts of California, have shown the presence of a considerable variety of mammalian species, but it has been impossible to group them into a fauna which might be regarded as a chronologic unit, owing to more or less variation in the age of these beds. The agencies involved in the accumulation of most of

the bone-bearing deposits have proved destructive to all but the larger forms. On the contrary, the caves, having acted to a greater or less extent as receptacles for the accumulation of surface material, might be expected to afford a more complete faunal record, as the conditions governing preservation are usually quite favorable. This expectation has been fully realized.

A large number of the species of Quaternary mammals collected from the caves are new. The greater number of the new species were obtained from the Potter Creek Cave, the exploration of which has already been described.* New material was also secured from the well known Mercer's Cave situated near the town of Murphys in Calaveras County. In the description of the following species the writer is particularly indebted to Dr. C. H. Merriam for information concerning the relationships of the rodents.

THOMOMYS MICRODON, n. sp.

Pl. 19, Figs. 1-3.

Type.— No. 5738, Univ. of Cal. Palae. Coll. The anterior portion of a skull without the mandible.

Locality.—Potter Creek Cave, Shasta Co., California.

This species closely resembles *Thomomys mazama* Merriam C. H., from which it differs in having a very prominent ridge on the side of the rostrum, marking externally the position of the alveolus of the superior incisor. The fossa above the ridge is deep. *Thomomys niger* Merriam C. H. has the fossa behind the incisor ridge almost as deep as in the fossil form, but differs in having the rostrum heavier and the molars much larger. In the fossil form, the rostrum is rather shorter and broader than in *Thomomys mazama,* and the premaxillae are less pointed.

The new species belongs to the yellow toothed division of the genus. The incisors are flattened on the anterior side, the anterior outer corner is angular and the teeth are sharply decurved.

*Science, N. S., Vol. XVII, No. 435, pp. 708-712, May 1, 1903; Univ. of Cal. Publ., Am. Arch. and Eth., Vol. 2, No. 1, 1904.

MEASUREMENTS.

Length of rostrum from base of P^4 to anterior surface of incisor	13.5mm
Length of rostrum from postero-inferior extremity of premaxillae to anterior surface of incisor	10.5
Greatest width of rostrum	7.5
Depth of rostrum from posterior extremity of nasals to margin of alveolus of P^4	11
Depth of rostrum from posterior extremity of nasals to postero-inferior extremity of premaxillae	9
Width across frontal between orbits	6.5
P^4, antero-posterior diameter	1.6
P^4, transverse diameter at widest part	1.5
M^1, antero-posterior diameter	1
M^1, transverse diameter	2
Width of incisor	2

APLODONTIA MAJOR FOSSILIS, n. sub-sp.

Pl. 19, Figs. 8 and 9.

Type.—No. 4160, Univ. of Cal. Palae. Coll. The right mandibular ramus, lacking the coronoid process and part of the angle.

Cotype.—No. 5265, Univ. of Cal. Palae. Coll. An imperfect cranium.

Locality.—Potter Creek Cave, Shasta Co., California.

Numerous lower jaws of an *Aplodontia* were found in all parts of the cave and at various depths beneath the surface of the cave deposit. The jaws all show the characters possessed by the type specimen. They differ from the typical *Aplodontia major* in having the dental foramen generally wider transversely. The ridge in front and below the masseteric fossa, in the fossil form, is usually continued across the lower side of the ramus and connected with the inner prominence of the angle, while in *A. major* a smooth space exists between the angle and the ridge in front of the masseteric fossa. In the fossil form the wall in front of the fossa above the angle, on the inner side of the ramus, is vertical for a longer distance below the opening of the alveolar canal than in the recent *major*. So far as it is possible to compare its dimensions with the measurements tabulated by Dr. C. H. Merriam,* the cranium agrees closely with *Aplodontia major.*

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*Annals N. Y. Acad. of Sciences, Vol. III, No. 10, Table facing page 328.

MEASUREMENTS.

Least width of rostrum in front of zygomatic arches	17.25mm
Least interorbital width	10
Length of superior molar-premolar series (except P^3) measured on alveoli	17.3
Palatal width between alveoli of P^4	6.25
Palatal width between alveoli of M^3	6.5
Distance between alveoli of inferior incisor and P^4	13
Length of lower molar-premolar series measured on alveoli	18

TEONOMA SPELAEA, n. sp.

Pl. 19, Figs. 4-7.

Type.—No. 5362, Univ. of Cal. Palae. Coll. The anterior two-thirds of a skull of an adult individual, in which the teeth are not much reduced by wear.

Locality.—Potter Creek Cave, Shasta Co., California.

Teonoma cinerea is the form nearest to this new species, but the rostrum and incisive foramina are decidedly shorter in the fossil form than in *cinerea.* Also, the premaxillae extend farther back beyond the nasals, the nasals taper more posteriorly and the frontals have a greater interorbital width in the new species than in *T. cinerea.*

A large number of lower jaws were found in various parts of the cave. They differ from the typical *Teonoma cinerea* in having the enamel loops of the molars more evenly balanced on the two sides of the axis of the tooth row. In *cinerea* the loops are much longer on the inner side than on the outer side. In the cave specimens there is comparatively little difference. As but one species of *Teonoma* is represented in the Potter Creek Cave, the mandibles are also referred to *Teonoma spelaea.*

MEASUREMENTS.

Length of rostrum from base of P^4 to anterior surface of incisor	19 mm
Width of rostrum in front of infra-orbital foramina	9
Depth of rostrum at middle of incisive foramina	9
Length of incisive foramina	13
Greatest width measured across both incisive foramina	3
Width across frontal between orbits	6.5
Length of superior molar-premolar series measured on alveolar borders	10.25
M^1, antero-posterior diameter measured on alveolar border	4.3
M^1, transverse diameter measured on alveolar border at widest part	2.3
M^2, antero-posterior diameter measured on alveolar border	3
M^2, transverse diameter measured on alveolar border at widest part	2.3

PLATYGONUS (?), sp.

Text, Fig. 1.

Locality.—Potter Creek Cave, Shasta Co., California.

Three specimens from the Potter Creek Cave are doubtfully referred to this genus. Two of them are superior molars which are so poorly preserved and so badly worn that little can be determined regarding them. When first examined, they were thought to be referable to a large species of tapir and were so listed in the writer's preliminary paper.* The third specimen, a lower molar corresponding in size with the teeth of the superior series, is represented in text figure 1. The crown

Fig. 1.

Fig. 2.

Fig. 1. *Platygonus*, sp. Potter Creek Cave.
Fig. 2. Camel tooth. Potter Creek Cave.

is divided into two transverse lobes by a deep valley which is unobstructed by ridges or tubercles. The notching of the anterior crest is slight, that of the posterior crest deep. A prominent extension of the cingulum posteriorly forms a heel which appears to have been more or less continuous around the external edge of the posterior lobe and to have joined a small tubercle at the outer margin of the transverse valley. This could not be well brought out in the figure as the enamel has been broken off, exposing the dentine. Anteriorly, there are traces of a narrow cingulum, but none exists internally. If the generic position of the specimen has been correctly determined, the remains indicate a species of *Platygonus* larger than any previously described.

MEASUREMENTS.

Antero-posterior diameter of inferior molar	30 mm
Transverse diameter at widest part	23.5

* Science, N.S., Vol. XVII, pp. 708-712, 1903.

CAMEL REMAINS.

Text, Fig. 2.

Although camels were abundant in California during the Quaternary, they did not play an important part in the fauna of the region about the Potter Creek Cave. Three molars of a camel were found in this cave but their fragmentary condition does not permit of a generic reference. One of them, a third inferior molar, is represented, natural size, in text figure 2, The heel has been gnawed off by rodents. Most of the cement and part of the external enamel layer have been removed by the same means.

EUCERATHERIUM COLLINUM Furlong and Sinclair.

Pl. 20, Figs. 1, 2.

Pub. Univ. Cal., Am. Arch. and Eth., Vol. 2, p. 18; Bull. Dept. Geol. Univ. Cal., Vol. 3, p. 412.

This ungulate is represented by abundant remains in the Potter Creek Cave, where it occurs in all bone-bearing strata. The specimens comprise numerous teeth from both jaws, loose podial elements, and broken horn-cores, some of which are supported by a part of the frontal. The various parts of the skeleton were not found associated, but there can be little doubt that they all belong to this genus. The horn-cores and the teeth of the superior series agree with the type specimen. As these remains do not indicate the presence of more than one species, the limb bones are also referred to *E. collinum.*

The various podial elements of *Euceratherium* agree closely in almost every particular with the corresponding bones in the feet of *Aplocerus,* excepting in size. Both anterior and posterior cannon-bones are short and robust. In the anterior cannon-bone, the posterior margins of the proximal articular surfaces lie in the same plane, while anteriorly they meet in an obtuse angle, producing an emargination of the anterior proximal border which is less marked than in *Aplocerus.* (Compare Pl. 20, figs. 2 and 3.) The nutrient foramen piercing the anterior surface of the bone above the distal condyles is also much smaller than in *Aplocerus.*

In the hind foot (Pl. 20, fig. 1) there is the same close agreement between the two genera. One of the most important differences is the close approximation anteriorly of the external trochlea and the condyle in the astragalus of *Euceratherium.* In *Aplocerus,* the two articular surfaces are separated by a wide groove.

The absence of close relationship between *Euceratherium* and the existing North American cavicorns is well brought out by a comparison of the foot structure, and especially of the cannon-bones. In *Ovibos* the cannon-bones are short and robust and agree, within a few millimeters, with the dimensions of the corresponding elements in *Euceratherium,* except in the length of the posterior cannon which is considerably greater in *Ovibos.** In the latter genus, the proximal facets of the anterior cannon-bone do not lie in the same plane posteriorly as in *Euceratherium.* Although there is close anatomical agreement with the feet of *Aplocerus,* the difference in size of the two genera is very great. The cannon-bones of the bighorn sheep are much larger in proportion to their width and are much less robust than in *Euceratherium.* In the domestic cattle, these bones are in some cases as robust as those of *Euceratherium* but are considerably longer. The extinct Bovinae of this Coast all have much broader and heavier cannon-bones.

It is apparent from these comparisons that no close relationship exists between *Euceratherium* and the goat-antelopes or the sheep. The cattle are excluded by fundamental differences in dental structure. The feet of *Ovibos* differ slightly in size and in minor anatomical peculiarities but the large horn-cores of that genus are of a different type from those of *Euceratherium.* No North American fossil forms are known from older formations which can be regarded as ancestral to the latter genus. It is possible that *Euceratherium* represents an Asiatic type which reached North America in the Quaternary along with the goat-antelopes, and that its ancestors are to be sought among the extinct forms of the Asiatic Pliocene.

* Dawkins, W. B. British Pleistocene Mammalia, Part V., Palaeont. Soc., 1872.

MEASUREMENTS.

Length of anterior cannon-bone measured on anterior surface	175 mm
Width of anterior cannon-bone measured at proximal end....	56
Width of anterior cannon-bone measured across distal condyles	61
Thickness of anterior cannon-bone measured at middle of shaft	22
Length of posterior cannon-bone measured on anterior surface	180
Width of posterior cannon-bone measured at proximal end....	49
Width of posterior cannon-bone measured across distal condyles	56.5
Thickness of posterior cannon-bone measured at middle of shaft	27
Greatest length of astragalus	62.5
Width of astragalus across proximal trochlea	37
Width of astragalus across distal condyles	42.5
Width of naviculo-cuboid	51.5
Greatest proximo-distal width of naviculo-cuboid at anterior border	18
Length of a phalanx of first row	58.5
Width of a phalanx of first row at proximal extremity	30.5
Width of a phalanx of first row at distal extremity	26
Length of a phalanx of second row	43.5
Width of a phalanx of second row at proximal extremity	29

APLOCERUS MONTANUS Ord.

Pl. 20, Figs. 3 and 4.

Parts of two anterior cannon-bones from the Potter Creek Cave are referred to this species. No. $\overline{4312}$ (Pl. 20, fig. 3) represents the proximal three-fourths of the right cannon-bone. The specimen shows traces of rodent grawing and is further disfigured by an exostitial growth at the proximal end, on the inner side of the bone. The middle of the shaft is slightly wider than the recent specimen of *Aplocerus* with which it is compared, but otherwise the two correspond closely in structure and dimensions. No. $\overline{4382}$ (Pl. 20, fig. 4), the distal half of a left anterior cannon-bone, is slightly larger than the corresponding element in *Aplocerus*, but in other respects does not differ from that genus. In the accompanying table, the dimensions of these two specimens and of *Aplocerus montanus* are given in parallel columns.

Cannon-bone	No. 4312	No. 4382	*A. montanus*
Width at proximal end	36 mm	....mm	35 mm
Width at middle of shaft	29	....	25
Greatest thickness at middle of shaft	13.5	....	13
Width across condyles	....	42.5	39.5
Width at nutrient foramen	....	35.5	32
Greatest thickness at nutrient foramen	....	15	14

NOTHROTHERIUM (?) SHASTENSE, n. sp.

Pl. 23, Figs. 1-5*a* and 8.

Type.—No. 8422, Univ. of Cal. Palae. Coll. An incomplete right mandibular ramus without teeth.

Locality.—Potter Creek Cave, Shasta Co., California.

This ground-sloth is represented in the cave collection by a large number of specimens. While teeth are wanting in the type, the peculiar shape and dimensions of the alveoli agree so closely with a number of molars from the same cave that there can be little doubt that they should be referred to the same species.

The type specimen lacks the greater part of the coronoid and angle. The anterior part of the symphysis is wanting, and the alveolar border is somewhat broken. The inferior border (Pl. 23, fig. 2) is strongly convex with the major convexity below the third lower molar. From this point it rises toward the symphysis, which is quite oblique instead of being almost vertical as in *Megalonyx jeffersonii.* The alveolar border in front of the second molar is somewhat broken and there is no trace of an alveolus for the first molar. The anterior opening of the alveolar canal is visible at the anterior extremity of the ramus. Its posterior opening is at the base of the coronoid process, on the outer side of the jaw.

The molar alveoli extend to the lower border of the ramus, from which they are separated by a thin shell of bone. All have parallel vertical walls, indicating that the specimen is of an adult individual.

In the second lower molar alveolus (Pl. 23, fig. 1) the lateral walls are inclined toward each other and if produced would meet anteriorly. The tooth occupying this alveolus was grooved on both lateral faces, dividing the column into two lobes of which the anterior was the smaller. Each lobe cor-

responds to a transverse ridge on the crown. The anterior wall of the alveolus is plane, while the posterior is slightly convex, with indications of a convex median rib.

The alveolus for the third molar is almost quadrangular in outline. The anterior wall is slightly concave, while the posterior is convex with a stronger convex rib situated about midway. The lateral walls meet the anterior face at a right angle. They are both grooved. A third lower molar of the left side, No. 8704 is represented on Plate 23, figures 4 and 4*a*.

The fourth molar alveolus is cordate in cross-section, with the indentation on the outer side. The anterior lobe produced by this groove projects beyond the posterior. The tooth is represented in the cave collection by three specimens, Nos. 8485, 8328 and 8339, but none of them have the triturating surfaces preserved.

Fourteen molars referable to this species were collected from the cave, principally from stratum E. Three were found in stratum A and several in the Buried Gallery from stratum E or F. Some of these are shown on Plate 23, figures 3-5*a* and 8. Several are considerably curved and are doubtless of the superior series. They correspond in size to the lower molar alveoli. The last superior molar of the left side, No. 8497 is represented on Plate 23, figure 8. It is a triangular tooth with the posterior side plane, the anterior convex, and the outer plane and meeting the posterior at a right angle. The triturating surface of the crown has been injured by rodents.

MEASUREMENTS.

Length of inferior molar series measured on alveolar border	53.5mm
Greatest antero-posterior diameter of the alveolus of M_2	15
Greatest transverse diameter of the alveolus of M_2	17
Greatest antero-posterior diameter of the alveolus of M_3	15
Greatest transverse diameter of the alveolus of M_3	17
Greatest antero-posterior diameter of the alveolus of M_4	16
Greatest transverse diameter of the alveolus of M_4	17
Depth of ramus below alveolar border of M_3	50
Least distance between alveolar border behind M_4 and inferior border of jaw	43.5
Superior molar No. 8702, antero-posterior diameter at triturating surface	12
Superior molar No. 8702, transverse diameter at triturating surface	15.5

Third inferior molar No. 8704, antero-posterior diameter at triturating surface 12
Third inferior molar No. 8704, transverse diameter at triturating surface 15
Superior molar No. 8337, antero-posterior diameter at triturating surface 12.5
Superior molar No. 8337, transverse diameter at triturating surface 15

MEGALONYX SIERRENSIS, n. sp.

Pl. 20, Figs. 5-8; Pl. 21, Figs. 1 and 2; Pl. 22, Figs. 1-3.

Type.—A lower jaw, in the Harvard Museum of Comparative Zoology, Cambridge Mass., and No. 8130, Univ. of Cal. Palae. Coll. Left scapula, scapho-trapezius, trapezoid and magnum; right calcaneum and navicular; several imperfect metatarsals; a broken claw; part of the tibia; several vertebrae and numerous fragmentary bones. The Harvard specimen and the material at the University of California belong to the same individual.

Locality.—Mercer's cave, near the town of Murphys, Calaveras County, California.

A part of the remains of this sloth were found when Mercer's cave was first discovered. The mandible was presented to the Harvard Museum of Comparative Zoology in 1887 by Mr. Z. A. Willard. A broken tibia, a calcaneum and some other fragmentary bones lay on a block of limestone to which they were cemented by stalagmite, and were for years an object of curosity to persons visiting the cave. Through the kindness of Mrs. Mercer, these were presented to the University of California in 1901, and permission was obtained by Professor J. C. Merriam to search for additional material. At Professor Merriam's request, the writer visited the cave during the summer of 1902, securing several fairly complete bones, notably the scapula, a number of podial elements and a few vertebrae. The bones were found in the crevices between large limestone blocks in the narrow part of the cave above the chamber known as "The Flower Garden." Some were fairly well preserved, being coated with stalagmite, others were exceedingly soft and spongy, and a large amount of the material was too fragmentary to be of use.

The cave is developed along a fissure, running parallel with the strike of the Carboniferous limestone. Radiating from the present entrance there is an earth fan, but deeper down the

fissure is almost choked by large fallen blocks. From the position of the sloth remains beneath some of these blocks it was evident that many of the latter had reached their present resting place at a later date than the bones. The abrupt descent precludes the idea that the animal wandered into the cave and there died. The best explanation of its presence seems to be that it was killed by a fall into the cave.

Through the kindness of Dr. C. R. Eastman, the specimen in the Harvard Museum was borrowed for examination. On the accompanying label it was stated that fragments of human crania were found associated with the mandible. Several human skeletons were found on the surface of the earth slope mentioned above, but these were probably comparatively recent Indian interments, while the sloth remains were from a much deeper part of the cave. Some of the human bones were incrusted with a very thin shell of stalagmite. It seems once to have been the custom of the Indians in this region to cast the bodies of the dead into such natural pits and caves as the region afforded. The human remains in Mercer's cave were apparently introduced in this way.

The ground-sloth bones collected are those of a young animal and differ in several respects from *Megalonyx jeffersonii* with which some of the dimensions compare favorably.

Two views of the *mandible* are given on Plate 21. The jaw is smaller than the corresponding element in *Megalonyx jeffersonii,* but this is due in part to the youth of the animal, in which the epiphytic elements were still distinct. The bone is invested with a layer of stalagmite which increases its size slightly. The second and fourth molars on the right side have the triturating surfaces broken. Some of the teeth are more or less coated with stalagmite. The canine molars are not much curved. The external dentine layer only could be distinguished. The internal convex rib is not quite central, and the concavity bounding it posteriorly is deeper than the anterior one.

A comparison of the dimensions tabulated on page 159 with the measurements of the mandible of *Megalonyx jeffersonii* given by Leidy,* shows that while the jaw is shorter and shal-

* J. Leidy, A memoir on the Extinct Sloth Tribe of North America. Smithsonian Contrib., Vol. VII.

lower, the posterior molars are of the same size as in that species.

The *scapula* (Pl. 22, fig. 1) is broken anteriorly, and lacks the supraspinous fossa, the scapular spine, and the coracoid process. These parts had disappeared before the specimen was discovered. At the anterior border of the glenoid fossa there is a rough surface for the attachment of a glenoid epiphysis like that found in young individuals of *Megalonyx jeffersonii.*

The glenoid fossa as preserved in the cave specimen is much longer and wider than in *jeffersonii.*

The anterior extremity of the superior border of that part of the scapula preserved is greatly thickened; the posterior extremity much less so. The posterior scapular border is strongly concave antero-posteriorly, differing in this respect from *jeffersonii.**

The subscapular fossa, so far as preserved, is smooth and basin shaped, without the alternation of ridges and sloping surfaces described by Leidy for *jeffersonii.*†

The supraspinous fossa is not shown, and the thickening of the anterior border mentioned above represents the base of the scapular spine. The infraspinous fossa is convex in all directions, with a low median ridge. In *jeffersonii* both fossae on the lateral surface of the scapula are deeply concave.‡

No foramina are indicated beneath the thin layer of stalagmite which preserves the specimen.

The *scapho-trapezius* (Pl. 20, figs. 7-8, *s-t*) is irregularly tetrahedral in shape, with a broad convex proximal facet for the radius. Distally, the most prominent facet is that for the trapezoid, which extends from the dorsal almost to the palmar margin of the bone, while in *jeffersonii* it is broadly separated from the latter. The facets for the magnum and lunar are not well preserved, as the specimen has suffered considerably from decay which has reduced its dimensions at several places. A similar though slightly larger and somewhat less complete bone was obtained from the Potter Creek Cave (No. $\overline{8201}$).

* J. Leidy, *op. cit.* Pl. VIII, fig. 3.
† *Ibid.* pp. 24 and 25.
‡ *Ibid.* p. 25.

The trapezoid (Pl. 20, figs. 7-8 *t*) is a small element, triangular in section when viewed from below. The facet for articulation with the scapho-trapezius which occupies the entire proximal surface is convex in dorso-palmar section and sigmoid transversely. The articulation is continued on the inner side of the bone as a surface inseparable from the proximal one. An oblong dorsal facet, concave in dorso-palmar section and a small ellipsoidal convex palmar facet, separated from the former by a groove, articulate with the magnum. A large distal facet, sigmoid in dorso-palmar section, articulates with the second metacarpal.

The *magnum* (Pl. 20, figs. 7-8 *m*) is broken, and has lost the articular surfaces for the scapho-trapezius and the lunar. There is an irregularly oval palmar facet for the scapho-trapezius, a concave roughly quadrilateral distal facet for the third metacarpal and two facets for the unciforme, a large irregularly elongate facet proximally, and a small acutely ovoidal facet on the anterior distal edge of the bone.

The *calcaneum* (Pl. 22, figs. 2 and 3) differs from the corresponding element in *Megalonyx jeffersonii* in the following respects:

(a) The postero-inferior extremity of the tuber calcis is directed toward the inner side, while in *jeffersonii* it is directed toward the outer side.*

(b) The inner surface of the tuber calcis is concave antero-posteriorly, while in the vertical direction it is convex below and plane or slightly concave above. In *jeffersonii*, it is concave in both directions.

(c) In *jeffersonii*, "posterior to the articular extremity, the calcaneum forms a large plate nine inches in depth, and only a fourth of an inch in thickness toward the center."† In the Californian species, this plate exceeds three-quarters of an inch in thickness toward the center and is never less than half an inch in thickness at the margin.

(d) While the neck of the tuber, behind the articular surfaces is only slightly wider vertically, than in *jeffersonii*, the

* J. Leidy, *op. cit.*, Pl. XII, fig. 6.
† *Loc. cit.* p. 41.

length of the calcaneum and the width across the fan-like expansion at the posterior extremity of the bone is far less.

The *navicular* (Pl. 20, figs. 5-6) has a shape slightly different from that in *jeffersonii,* being irregularly triangular in outline, with the angles broadly rounded. On the distal surface, the facets for the cuneiform bones are separated posteriorly by a sharp ridge, while in Leidy's figure* of the navicular of *jeffersonii* they are represented as separated by a groove.

Two *vertebrae* are preserved, a caudal and an anterior dorsal. In the caudal, the vertebral canal is low and broad and the transverse processes, arising from the centrum are directed posteriorly. The epiphyses are wanting and the sub-epiphytic margins are bent inward toward the median plane of the centrum. In the dorsal, the transverse processes are broad and are situated high up on the neural arch, rising above the zygapophyses. The spine is short with acute anterior edge. The neural canal is circular. The centrum is not preserved. Below the prezygapophyses, a small, hemispherical process rises from the anterior surface of the neural arch.

Fragments of several other bones were found, but they are all too incomplete to describe.

The species is separated from the Californian forms of the same genus described in the present paper by the size of the teeth and the shape of the jaw, in which respect it resembles *Megalonyx jeffersonii,* differing from that species, however, in many skeletal particulars. It has not been identified from the Potter Creek Cave, unless the doubtfully determined specimen referred to *Megalonyx jeffersonni* can be shown to belong here.

The specific name refers to the locality, in the foot hills of the Sierra Nevada Range.

MEASUREMENTS.

Length of ramus from anterior extremity of symphysis to condyle inclusive	261.5 mm
Length of lower molar series (M_2-M_4)	63
Length of symphysis externally	81
Depth of jaw below M_2	75
Depth of jaw below M_4	70
Diameters of lower molar crowns not including stalagmite:	

* J. Leidy, *loc. cit.* Pl. XIII, fig. 8.

M_1, antero-posterior diameter of grinding face	28	mm
M_1, transverse diameter of grinding face	12	
M_2, antero-posterior diameter	17	
M_2, transverse diameter	20	
M_3, antero-posterior diameter	16	
M_3, transverse diameter	23	
M_4, antero-posterior diameter	17	
M_4, transverse diameter	23.5	
Greatest length from glenoid cavity of scapula to superior scapular border	295	
Distance from glenoid border to posterior inferior angle of scapula	136	
Greatest width of glenoid cavity of scapula	102	
Greatest length of glenoid cavity of scapula	100	
Greatest length of calcaneum	142	
Greatest width of fan-like expansion of tuber calcis	131	
Width of neck of tuber calcis at narrowest point	67	
Greatest width of posterior margin of tuber calcis	39	
Least width of posterior margin of tuber calcis	13	
Distance from posterior extremity of tuber to inferior border of astragalar facet	106	
Greatest dorso-plantar diameter of navicular	70	
Greatest transverse diameter of navicular	64	

MEGALONYX (?), sp.

Pl. 23, Fig. 6.

Locality.—Potter Creek Cave.

The large molar shown on plate 23, figure 6 (No. 8705) is doubtfully referred to *Megalonyx*. It is oblong in outline, with one of the narrow lateral faces convex and the other with a median groove. The remaining faces are respectively broadly concave, and convex with a low median convex rib. At either extremity of the deep groove crossing the triturating surface there are shallow concavities separated from each other by a convex surface. In this respect, and in the shape of the crown and its superior size, the tooth is unlike that of any species of *Megalonyx* known from this state. In shape the tooth is also unlike *Mylodon*. It is broken off a short distance below the triturating surface.

Measurements.

Antero-posterior diameter of molar at widest part	16	mm
Transverse diameter of molar	27.5	

MEGALONYX WHEATLEYI Cope (?).

Pl. 23, Fig. 7.

Locality.—Potter Creek Cave.

A single specimen (No. 8203) is referred to this species. It has the characteristic triangular form of the superior molars of *Megalonyx*, with the apex of the triangle rounded and the base slightly grooved. The remaining faces are respectively plane and convex. In dimensions, it agrees with Cope's *Megalonyx wheatleyi*, and in the absence of negative characters has been referred to that species. *Megalonyx wheatleyi* was described from material collected from the ossiferous deposit filling a fissure exposed in a quarry at Port Kennedy, Pennsylvania. The posterior molars can be distinguished from those of *Megalonyx jeffersonii* only by their inferior size. The tooth from the Potter Creek Cave is intermediate in this respect between *Nothrotherium shastense* and *M. sierrensis.* It is slightly wider at the base of the pulp canal than at the triturating surface, indicating that the animal was not fully mature.

MEASUREMENTS.

Antero-posterior diameter of molar at triturating surface....	12
Antero-posterior diameter of molar at margin of pulp canal...	12.5
Transverse diameter of molar at triturating surface..........	19.5
Transverse diameter of molar at margin of pulp canal........	20.5

MEGALONYX JEFFERSONII Leidy (?).

Locality.—Potter Creek Cave.

This identification is based on a fragmentary canine-molar (No. 8620) which agrees in dimensions with *Megalonyx jeffersonii.* Although not much curved, the obliquity of a small part of the triturating surface preserved indicates that the tooth probably belongs to the superior series. The convex rib is situated midway on the inner side of the tooth with a well marked concavity on either side. It is possible that this tooth should be referred to *Megalonyx sierrensis,* in which the upper molars are not known, but the convex rib in the lower canine-molars of that species is less centrally located than in the specimen in question. If the tooth were entire, the measurements given below would be slightly increased. In particular, the antero-posterior diameter would be lengthened one or two millimeters.

MEASUREMENTS.

Antero-posterior diameter of canine-molar....................	34mm
Transverse diameter of canine-molar	16

EXPLANATION OF PLATE 19.

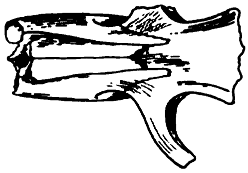
Figures 1-7 are reproduced one and one-half times natural size; figures 8-11 are reproduced natural size.

Figs. 1-3. *Thomomys microdon* n. sp. Superior, inferior and lateral views of the type specimen.

Figs. 4-6. *Teonoma spelaea*, n. sp. Superior, lateral, and inferior views of the type specimen.

Fig. 7. *Teonoma spclaea*. Superior view of the mandible.

Figs. 8, 9. *Aplodontia major fossilis*, n. sub-sp. External and internal views of the right ramus of the mandible.



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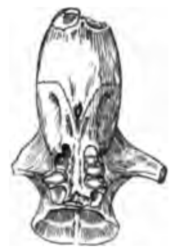

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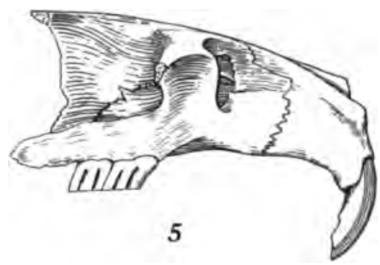

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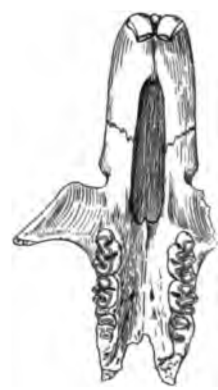

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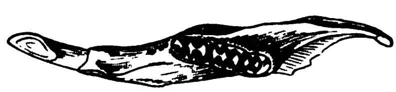

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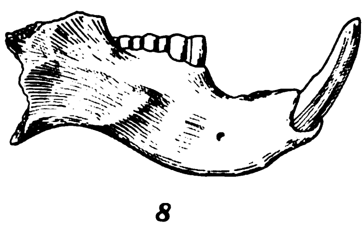

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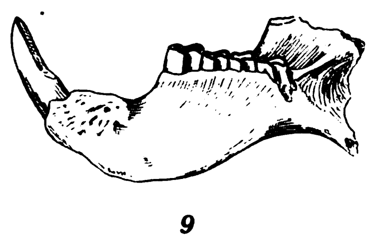

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EXPLANATION OF PLATE 20.

All figures are reproduced one-half natural size.

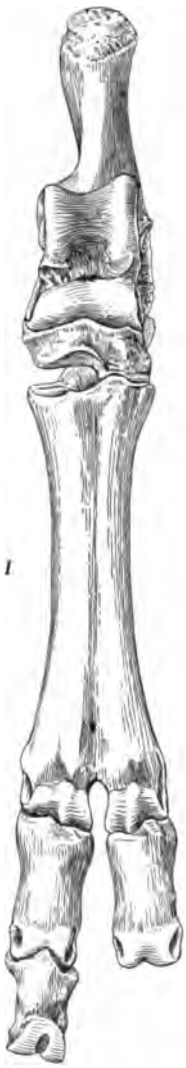
Fig. 1. *Euceratherium collinum.* Left pes. Several dissociated elements are combined in the drawing.

Fig. 2. *Euceratherium collinum.* Left anterior cannon-bone.

Figs. 3, 4. *Aplocerus montanus.* Portions of anterior cannon-bones. The proximal three-fourths of the right cannon-bone is represented in figure 3, while 4 shows the distal half of the same element of the opposite side.

Figs. 5, 6. *Megalonyx sierrensis*, n. sp. Views of the proximal and distal surfaces, respectively, of the right navicular.

Figs. 7, 8. *M. sierrensis.* Views of the dorsal and distal aspects of the left scapho-trapezius (*s-t*), trapezoid (*t*), and magnum (*m*). One of the facets for articulation between the scapho-trapezius and lunar is seen at (1).



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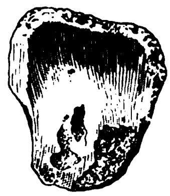

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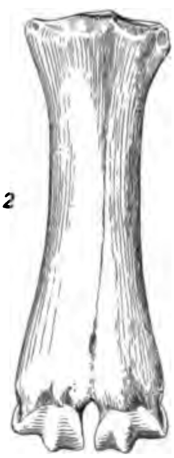

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EXPLANATION OF PLATE 21.

Both figures are somewhat more than one-half natural size (*i.e.* $\times .62$).

Figs. 1, 2. *Megalonyx sierrensis*, n. sp. Superior and lateral aspect of the mandible. Reproduced from photographs of the specimen in the Harvard Museum of Comparative Zoology.

1

2

EXPLANATION OF PLATE 22.

All figures are reproduced one-half natural size.

Fig. 1. *Megalonyx sierrensis*, n. sp. Left scapula, external view. The supraspinous portion has been broken away.

Fig. 2. Articular surface of the right calcaneum.

Fig. 3. Inner side of the right calcaneum.

1

2

3

EXPLANATION OF PLATE 23.

All figures are reproduced natural size.

Figs. 1, 2. *Nothrotherium* (?) *shastense*, n. sp. Right ramus of the mandible viewed from above and from the inner side.

Figs. 3, 3*a*. *N.* (?) *shastense*. A superior molar of the same crown and lateral views, showing the curvature of the tooth and the pattern of the triturating surface.

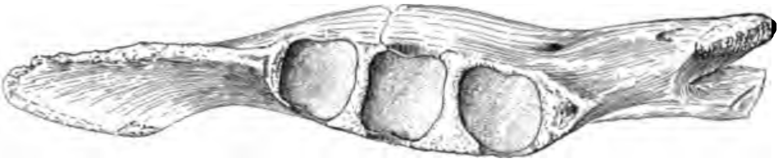
Figs. 4, 4*a*. *N.* (?) *shastense*. Left third inferior molar, showing the pattern of the triturating surface and the concave anterior wall of the tooth.

Figs. 5, 5*a*. *N.* (?) *shastense*. Superior molar No. 8337, referred to the same species as the above, showing the triturating surface and the convex rib on the side of the tooth crown.

Fig. 6. *Megalonyx* (?). View of the triturating surface of a molar (No. 8705, doubtfully referred to this genus.

Fig. 7. *Megalonyx wheatleyi* (?). Crown view of amolar. The triturating surface is slightly broken.

Fig. 8. *Nothrotherium shastense*. Triturating surface of the fifth superior molar of the left side. The tooth has been damaged by rodent gnawing and its outline is restored by a broken line. The restoration is based on the shape of the tooth shown at the margin of the pulp canal.



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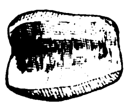

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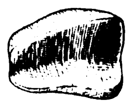

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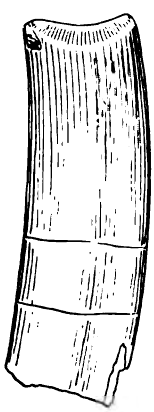

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4a

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7

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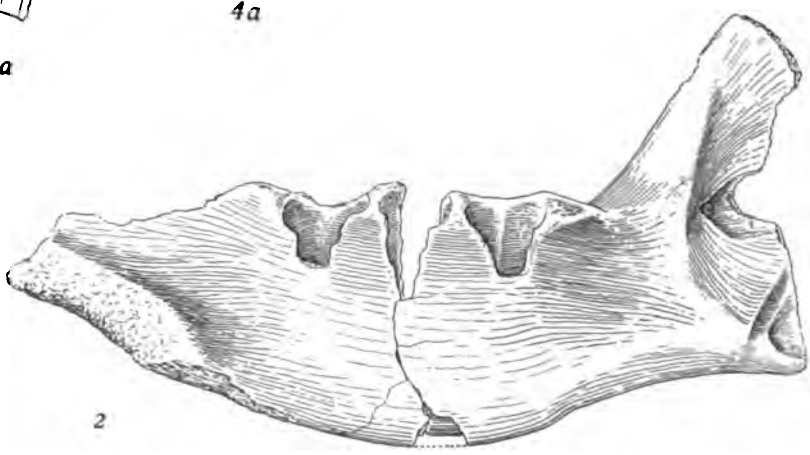

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